Cedar Falls Hydroelectric Works
On Cedar Falls Road, 3.5 miles south
of Interstate 90
Cedar Falls
King County
Washington

HAER No. WA-15

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
Western Region
National Park Service
U. S. Department of the Interior
San Francisco, California 94102

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HISTORIC AMERICAN ENGINEERING RECORD

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Location:	On Cedar Falls Road, 3.5 miles south of Interstate 90 Cedar Falls, King County, Washington UTM: Section 11, Township 22N, Range 8E Section 4, Township 22N, Range 8E Quad: North Bend, 1:24000
Date of Construction:	1913-1914
Engineer:	A. Dimock, City Engineer
Builder:	Seattle Engineering Department
Original Use:	Hydroelectric and water supply facility
Present Use:	Hydroelectric and water supply facility
Significance:	The assemblage of industrial structures and architectural features that comprise the Cedar Falls Hydroelectric Works Historic District occupies and important position in the political and social evolution of the city of Seattle. The facility was the first publicly-owned electrical generating plant for the city, and its initial development at the turn of the century was greatly facilitated by the popular movements for political and business reform and public accountability that swept across the nation.
Report Prepared by:	David W. Harvey and Kent Shoemaker Chronicles & Design 1313 N. Shore Drive Bellingham, Washington 98226 August 1986
Edited, Retyped and Transmitted by:	Jean P. Yearby, HAER, 1988

The Beginning of Public Power in Seattle

The first electrical lighting in Seattle was provided in 1886 by a private utility. The Seattle Electric Light Company was the first to organize and the first utility west of the Mississippi River to use Edison's three-wire direct current system. Within 10 years, nearly 30 small "cottage industry" lighting plants had been established in the city. But with the perfection of alternating current in the early 1890s, long-distance transmission became possible and the way was opened for large central general plants that could serve wide areas. This development at once made the electric industry very capital-intensive, and large holding companies soon entered the field and absorbed the small independent producers. The Stone and Webster holding company of Boston began a campaign to acquire Seattle's generating facilities in 1899 and by 1900 held a virtual monopoly over electricity sales in the city. They consolidated their holdings into the Seattle Electric Company (parent company of Puget Sound Power and Light Company), but maintained strict control from their Boston headquarters. In 1900, their standard electric rate was .20 per kilowatt-hour.

The high rates and poor service provided by the company led to strong citizen pressure to develop an alternative supplier of electricity. The situation furthermore gave impetus to reformers who felt public ownership was the only way to break the "corrupt ties" between city officials and the private utilities (Soderberg, 1986). Leading the fight for a municipal power system in Seattle was R. H. Thomson, city engineer from 1892 to 1911 and the man responsible for construction of the city water system and many other projects. In 1893, Thomson first called for the development of a public power system as the best way to secure efficient and economical electrical power for Seattle (Ross 1912-13). He was instrumental in obtaining the necessary State legislation and altering the City Charter to clear the way for a public power plant.

With the completion in 1901 of the city-owned water system utilizing the Cedar River, seattle could at last enjoy abundant, pure water at bargain prices. This example further convinced the public of the potential benefits of municipal electrical supply. In 1902, the City Council responded to the public consensus by submitting a $590,000 bond issue to finance the construction of a city-owned power plant on the Cedar River to the voters. It was approved by a ten-to-one margin, thus clearing the way for Seattle's first municipal electrical generating plant.

Public Power and the Progressive Era

The public power movement in Seattle reflected a nationwide trend toward public ownership and accountability, business and political reform, and conservation of natural resources. Known as the "Progressive Era," this period was characterized by public movements to correct the abuses brought about or intensified by the rapid industrialization of the nation. Private ownership was equated with political corruption, lack of public accountability, and resource exploitation, and the reformers saw public ownership as the best solution to these problems.

This period saw the rise of Northwest progressives to regional and national prominence. Besides R. H. Thomson, other Seattle notables included George Cotterill, the city's reform mayor from 1912-1914 (Fitzsimons 1984), and J. D. Ross, the electrical engineer who started his career at Cedar Falls in 1903. Ross was appointed Seattle's Superintendent of Lighting in 1911 and became a national spokesman for public power. He was chosen by Franklin Roosevelt to be the first head of the Bonneville Power Administration in 1936.

Historical Technological Significance

As one of the earliest "high head" power installations in Washington, the Cedar Falls facility played a significant role in hydroelectric power development in the western United States (Dick 1975; Soderberg 1986). The four generating units (Units 1-4), installed at Cedar Falls between 1903 and 1909, were designed specifically for the high-head/low-volume conditions of the American West and featured the latest Lombard-type N governors and relief valves (Electrical World, June 1, 1912). The installation of the two larger capacity reaction turbines (Units 5 and 6) in 1921 and 1929 built on the success of the pioneering high-head turbines (Soderberg 1986).

Both the original physical layout of the generating facilities and the manner in which the complex was constructed reflect its municipal ownership and piecemeal funding by public bond issues. Private funding would have allowed larger initial capital outlays, thereby permitting the construction at the start of a single large fireproof structure to house both generators and transformers. Public funding, however, was less certain and generally resulted in the selection of least-cost alternatives. This led to construction at Cedar Falls of an inexpensive but flammable timber powerhouse, a number of separate fireproof but flammable timber powerhouses, and a number of separate fireproof switching and traNsformer buildings. The fireproof concrete power plant was not completed until 1927-28.

Construction of the Cedar Falls Hydroelectric Facility

After the Cedar Falls bond issue passed in 1902, construction began immediately on a 30x30-foot wood frame power plant at Cedar Falls. A rock-filled timber crib dam, 250 feet long, was emplaced one-half mile below the outlet of the natural Cedar Lake, raising the lake level 13 feet. The new reservoir was later named Chester Morse Lake, in honor of Chester Morse, long-time head of the Seattle Water Department. A three and one-half mile, 49-inch diameter wood penstock was constructed to conduct water from the dam to the generating plant. For the last 1,000 feet, a riveted steel penstock conducted the water to the turbines.

Within the powerhouse, the original two 2,000-horsepower Pelton impulse wheels furnished power to two 1,200-kw generators. The wheels were connected directly to the generators, and a Lombard governor maintained each machine at 1,400 rpm (Electric World and Engineer, 1904). Other buildings in the initial facility at

Cedar Falls included a 12x70-foot concrete and stone transformer switch house, a 30x40-foot concrete and stone switch and lighting arrester house, an oil house designed for gravity feed, a 20x20-foot timber framed workehop, and a 12x20-foot switch room attached to the power plant (Electrical World and Engineer, 1904).

On January 1, 1905, the Cedar Falls plant assumed Seattle's streetlight load. In September of that yoar, the City Council authorized general sale of the surplus power at 8.5 cents/kilowatt-hour.

By undercutting Seattle Electric Company's rates, the public utility captured a large market and the demand for Seattle's municipal electricity soon outstripped supply. In 1908, an $800,000 bond issue was passed, authorizing the addition of generating units 3 and 4: two 8,000-horsepower Francis reaction turbines driving 4,000-kw Westinghouse generators (McWilliams 1955). The crest of the timber crib dam was raised six feet and new penstocks, a stone switch house, and an addition to the powerhouse were conetructed.

Within two years of these additions, the plant was overloaded once again. Because a larger water storage reservoir was needed in order to develop the full power potential of the site, Seattle issued $1,400,000 in municipal revenue bonde to fund construction of a 215-foot high, 961-foot-long cyclopean masonry gravity dam one and one-half miles downstream from the crib dam (see Figures 1, 2, 5, 5, 7, and 8). Constructed in 1913-1914, the new masonry dam was intended to allow the lake level to be raieed an additional 58 feet (to 1590-foot elevation), enlarging its eurface area from 1.91 to 5.23 square miles. The dam was originally designed to conserve the entire runoff of two consecutive wet years for power purposee (Electrical World, June 1, 1912).

Dam construction required 180,000 cubic yards of cyclopean masonry, 15 percent of which consisted of large boulders (Power-Factory Number, n.d.). Termed aggregate, these bouldere were available from nearby gravel bede and spillway excavations of the spillway. A square-notched spillway was designed that measured 40 feet at the base (see Figures 6 and 7). It was intended to discharge 10,000 cubic feet of water per second, maintaining a maximum level 5 feet below the crest of the dam during the heaviest flood periods (Power-Factory-Number, n.d.). This service spillway was never completed. Instead, a "temporary" spillway was left near the center of the dam.

At the dam's south end, an 11-foot-diameter, concrete-lined underground power tunnel was constructed. The intake of water from the masonry pool to this tunnel is controlled by valves in the upper gatehouse (see Figuree 1, 2, 6, and 7). The tunnel conducts water from the masonry pool, 1,500 feet downstream to the lower gate valve house (see Figures 1, 3, 10-11), where it connects to three steel penstocks. Hydraulically-operated gate valves control the flow from the tunnel to the penstocks. As they emerge from the gatehouse, the penstocks cross the Cedar River gorge on an open spandrel concrete arch bridge (see Figure 3) and continued 7,500-feet downstream to the power plant (see Figure 4).

Soon after construction of the masonry dam was commenced, however, extensive seepage from the masonry pool was observed. The seepage outflow was significant and seriously impaired the value of the reservoir at high pool elevations. There were repeated attempts at sealing the north embankment of the masonry pool, but success was limited. Seepage emerged north of Cedar falls, where the marshy valley near Rattlesnake Prairie became a lake, inundating most of the town of Moncton. Cedar Falls was plated as an adjacent townsite to the east.

Despite attempts to seal the masonry pool, the continuing seepage resulted in the Boxley Creek Blowout of December 24, 1918 (Mackin 1941). As a result of this event and the uncorrected seepage, the reservoir was never filled to full pool (1,590 feet); rather, it has a maximum operating level more than 20 feet below the design level.

In 1921, a new concrete frame powerhouse (see Figure 4) was constructed. In this structure, a 15,000-kw Westinghouse generator (Unit 5), driven by a 20,000 horsepower Francis reaction turbine manufactured by Pelton, was installed. An identical generator, Unit 6, was installed in 1927-29.

By 1928, water used to operate all of the generating equipment originated at the intake of the masonry dam. The crib dam was only used to regulate the water level between the dams (masonry pool) at the lake elevations below 1,546 feet,, in order to minimize seepage loss. In 1932, the city dismantled the first four generating units and subsequently demolished the timber frame power plant, the oil house, the switch and arrester house, and the power plant workshop. Generation Units 1 and 2 went to Ketchikan, Alaska, and Units 3 and 4 went to South America. The wood stave penstocks were also removed and replaced entirely with riveted steel pipelines (Soderberg 1986).

Seattle City Light did not modify the power plant again until 1956, when it was decided to automate the plant. These improvements included the construction of a new 119,000-volt transmission line and were completed in 1961 (O.P.A. 1984).

The following is a descriptive summary of the extant historic buildings and structures in the Cedar Falls complex (see site plan, Figure 4).

Timber Crib Dam

The crib dam has undergone extensive modifications and deterioration, and lacks most of its original architectural and engineering integrity. It is not considered eligible for listing in the National Register and is not included in the historic district.

Masonry Dam

Constructed in 1912-14, the 961-foot-long dam has retained much of its original appearance. The cyclopean style of construction, consisting of mass concrete containing approximately 15 percent large boulders, was a standard design of that period. The dam rises 160 feet above the riverbed and 215 feet above the deepest part of the rock foundation. The concrete structure of the dam is 195 feet thick at its base, tapering to 15 feet at the crest, which stands 1,600 feet above sea level. The crest features concrete masonry walls and a concrete walkway, together with the upper gate house adjacent to the spillway. The dam has been modified by the installation of a pass-through pipe and valve which replaced an originally installed but nonoperative pipe and valve. The dam was originally designed to raise the lake level 58 feet above its maximum natural elevation (1,590 and 1,532 feet, respectively) and to increase the lake's storage capacity from 1.91 to 5.2 square miles. Because of seepage problems, the reservoir is operated with a maximum elevation at least 20 feet below the design elevation.

Concrete Upper Gate House

Adjacent to the masonry dam spillway, the concrete upper gate house has retained much of its original appearance. Measuring 33 feet (front and rear) by 24 feet (sides), this one-story, flat roof building has a lightly inscribed cornice, metal-line roof edge, and double-hung, multilight windows symmetrically placed. The interior has three sluice gate valve mechanisms and a valve mechanism for a steel outlet pipe for excess water disposal.

Concrete-Lined Power Tunnel

This underground tunnel was built between 1912 and 1914 to connect the masonry dam reservoir (masonry pool) with the penstocks at the concrete lower gatehouse (see below). The tunnel measures 1,500 feet in length and 11 feet in diameter. It remains unaltered and is still in use.

Concrete Lower Gatehouse

Built in 1914 at the west end of the power tunnel, this one-story, concrete valve gatehouse is similar to the upper gatehouse in style and form. Measuring 30 feet (front-rear) by 22 feet (sides), the building has a lightly inscribed cornice below a slightly pitched metal gable roof. The windows are of fixed sash and pivot type with multilights. Inside, there are three "Big Gate" valves where the power tunnel attaches to the two steel penstocks that conduct water 7,500 feet downstream to the generating plant.

Open Spandrel Concrete Arch Bridge

Measuring 187 feet in length and 24 feet in width, the bridge was built in 1914 and was designed to carry three penstocks across Cedar River gorge from the lower gate house. At present, it carries two 78-inch diameter penstocks and one 12-inch diameter pipeline (added in 1969). Although unaltered, the bridge has suffered some deterioration.

Penstock Piers

In the floor of the Cedar River canyon are several concrete piers, built to support the original penstock crossing the river canyon.

Timber Powerhouse Foundations

Constructed in 1904, these stone and concrete foundations adjacent to the City Light Building are the only remains of the original timber power plant. The brick arches mark the terminus of the original penstocks, where they connect with turbine Units 1-4.

Transformer Switch House

Built in 1980 with walls of stone and cement mortar, this flat roof, one-story building measures 18 feet by 2 inches by 32 feet, 9 inches, with double-hung, wood frame windows with wood sills and arched, radiating voussoirs over the windows and doors. Currently used for storage, the building remains largely unaltered. Conduit holes for electrical leads still exist below the projecting eaves.

Concrete Transformer Switch House

Built in 1904, this one-story building remains largely unaltered (except for interior modifications) and is presently used for storage. Measuring 73 feet by 13 feet, 6 inches, the building has a steeply-pitched, metal gable roof (the roof was originally flat) and fixed-sash and pivot windows with multilights. The holes below the extended eaves were for electrical conduits.

City Light Building

Built in 1908, this concrete, one-story industrial building is attached to the power plant machine shop/garage. Present used for storage and office space, the building originally housed generating equipment (Bell 1986). Except for interior modifications, the building has retained its original appearance. Measuring 54 feet, 9 inches by 18 feet, the structure has a steeply-pitched metal gable roof, fixed-sash, multilight windows, separated by concrete, and a stone and concrete foundation.

Remains of Three Riveted Steel Penstocks

Built in 1908 and measuring 4 feet in diameter, these penstocks are now used for fire water. They extend one-quarter mile upstream, where they connect to the current penstocks (Bell, 1986). All of the penstocks are located to the rear of the power plant.

Concrete Power Plant

This generating plaNt was constructed in several stages. The original structure was built in 1921 and 1928, and a machine shop/garage building was added in the 1950s. The main building measures 129 feet by 44 feet with a 50-foot ceiling. This two-story, industrial-style building has fixed sash, multilight arched windows placed symmetrically to extend to the second story. Rows of small pivot windows are situated below the cornice, and the flat roof is supported by riveted steel trusses (O.P.A. 1984). The walls are constructed to poured concrete. The building is largely unaltered, except for the addition of the aforementioned one-story machine shop/garage. Measuring 44 feet by 48 feet, this shop replaced the original west end addition to the power plant.

The interior has a 50-foot ceiling with a 40-ton electrical crane. The generating equipment consists of Units 5 and 6. Unit 5 was added in 1919-21, while Unit 6 was added in 1927-29. Each unit consists of a Francis reaction turbine of 20,000 horsepower, built by Pelton, connected to a 15,000-kilowatt maximum capacity (at 450 rpm under a 600-foot head) Westinghouse generator.

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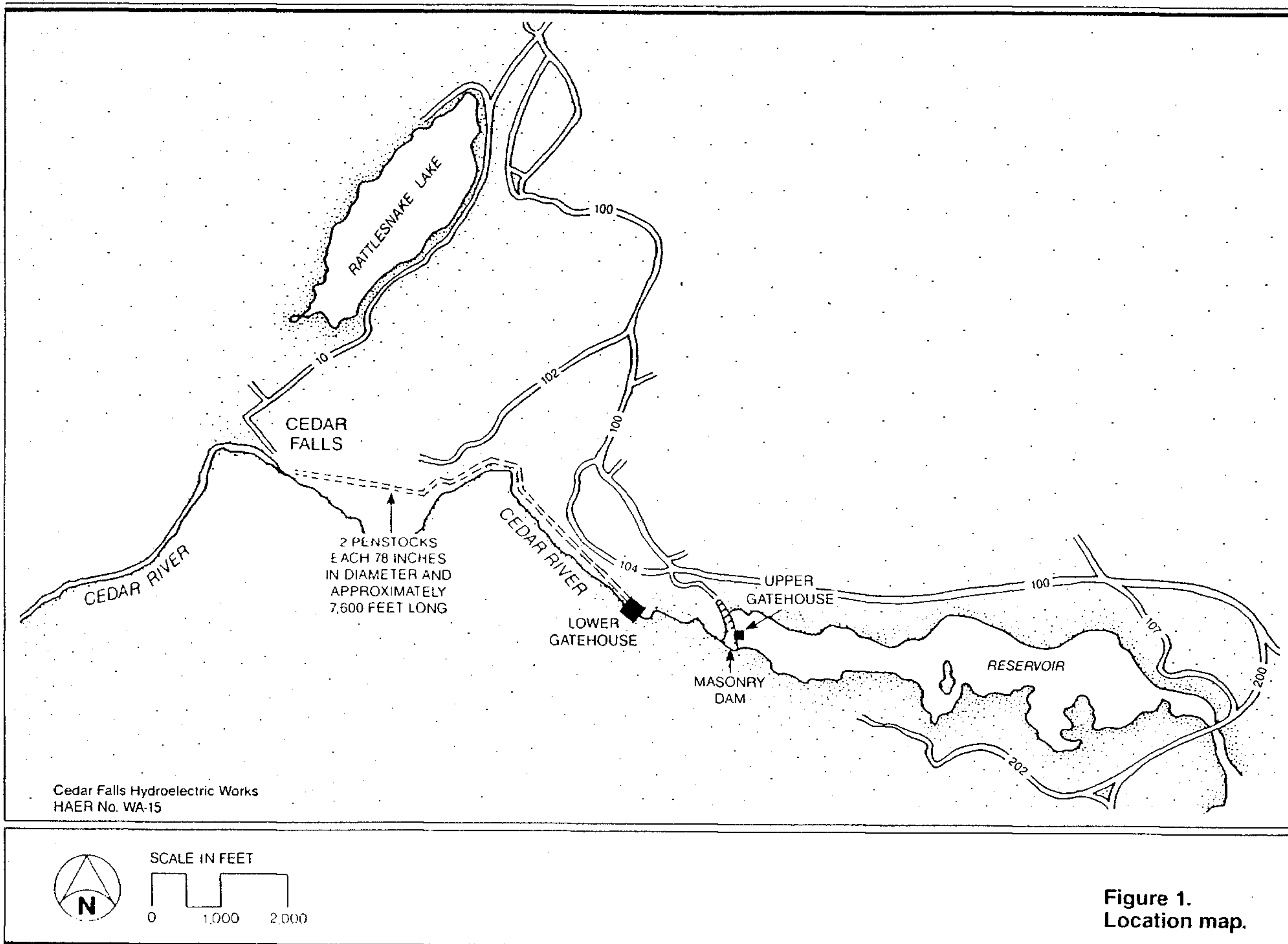

Figure 1.
Location map.

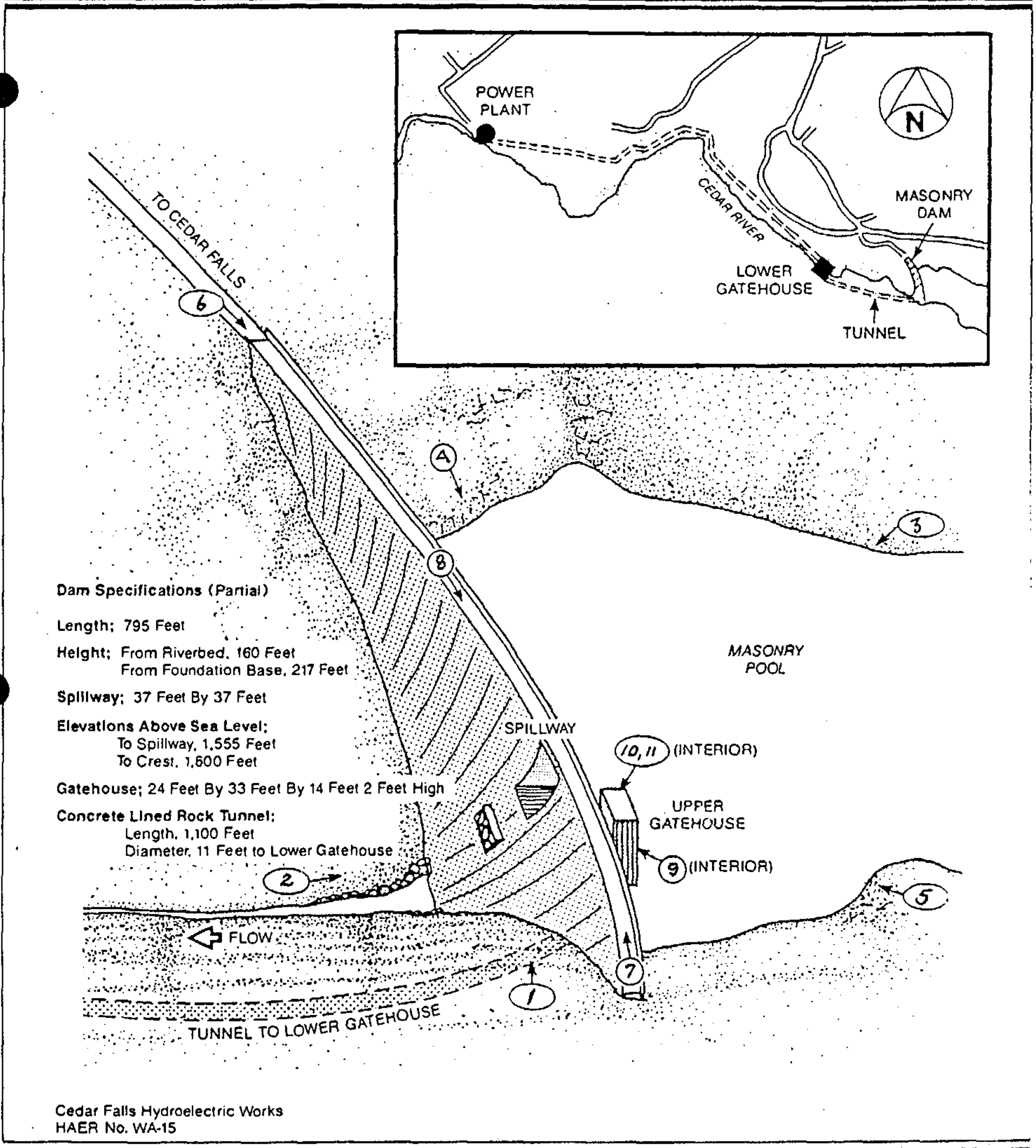

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Figure 2.
Cedar Falls Masonry Dam.

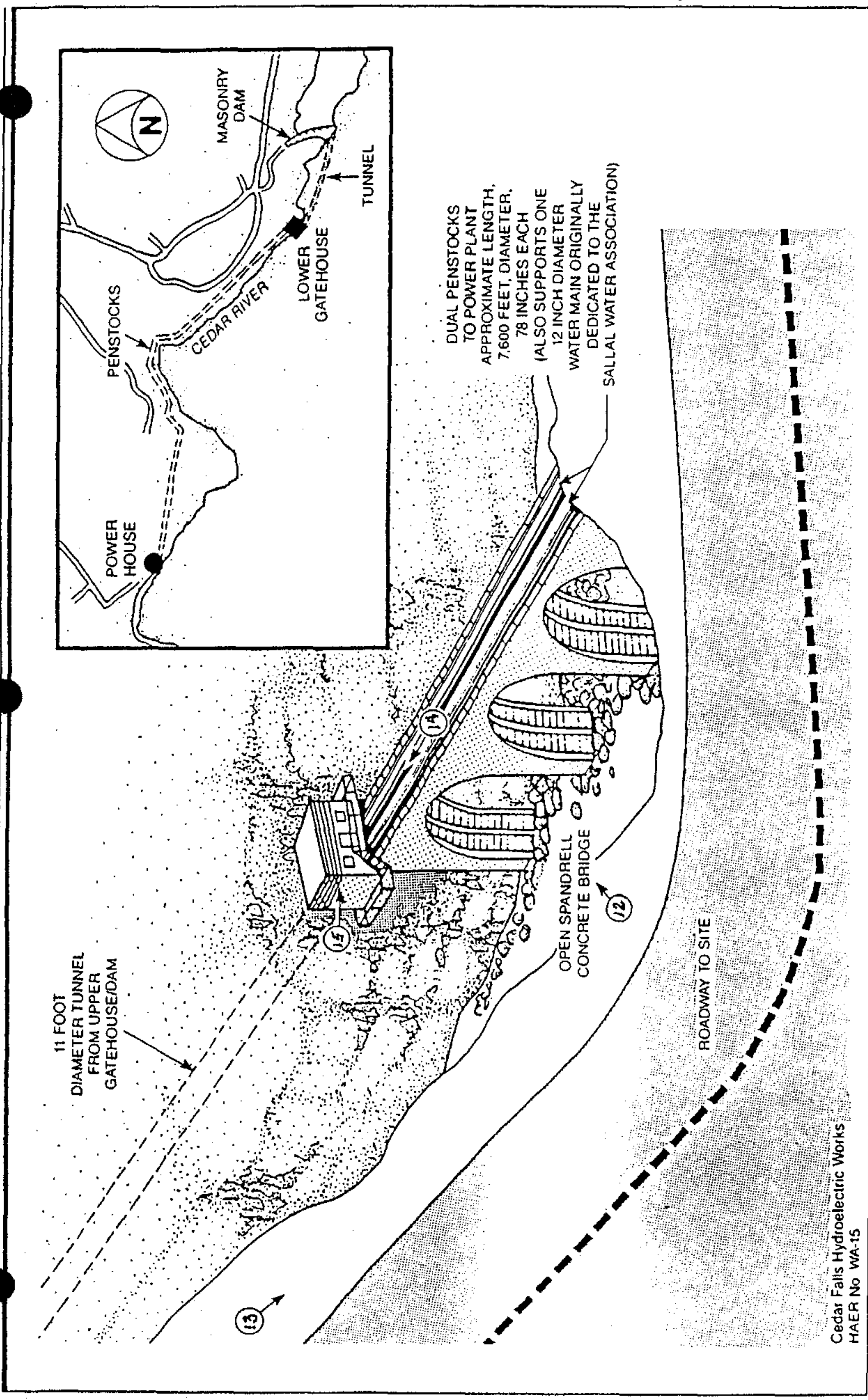

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Figure 3.
Cedar Falls Lower Gatehouse.

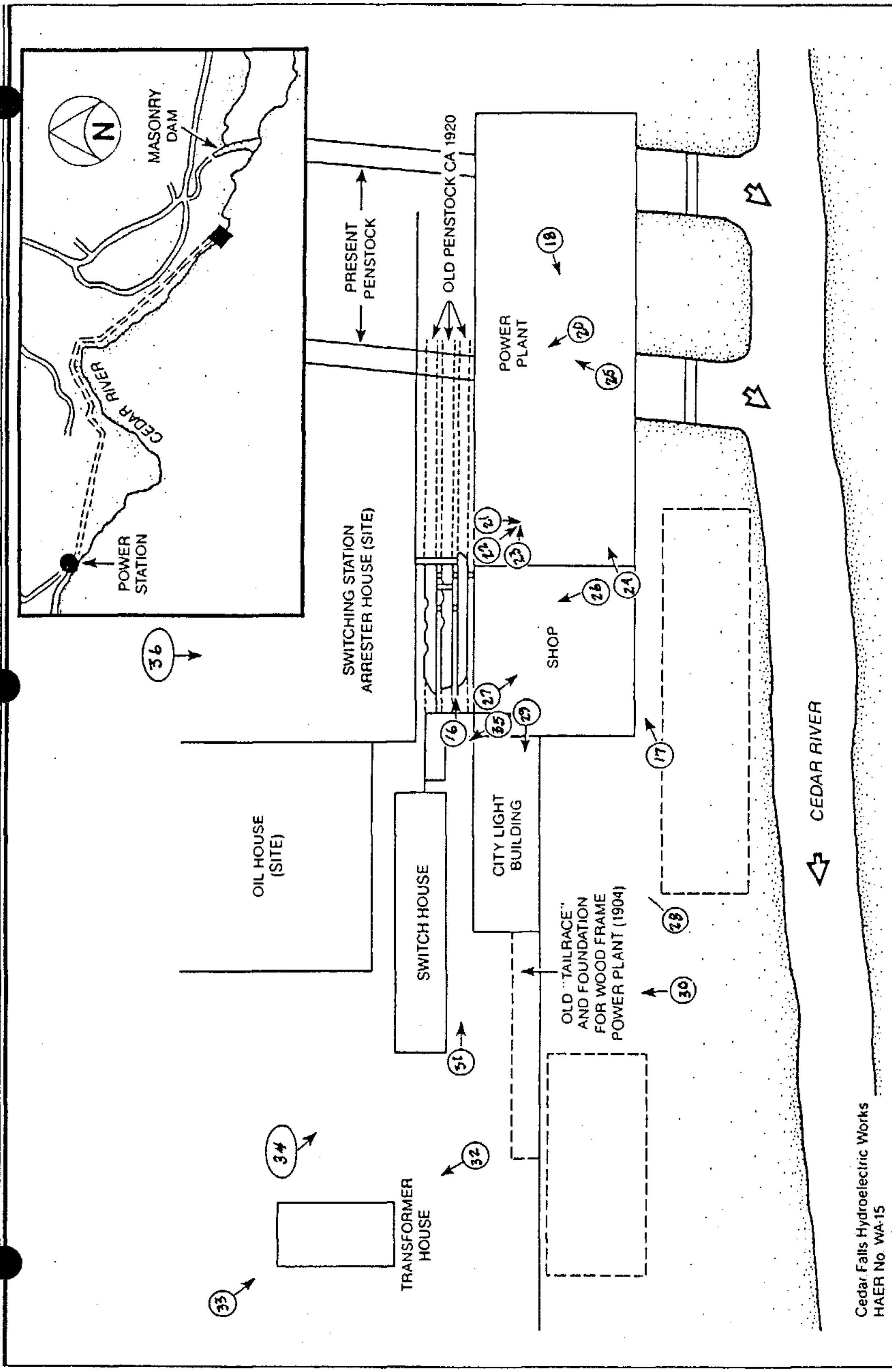

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Figure 4.
Cedar Falls Power Station plan view.

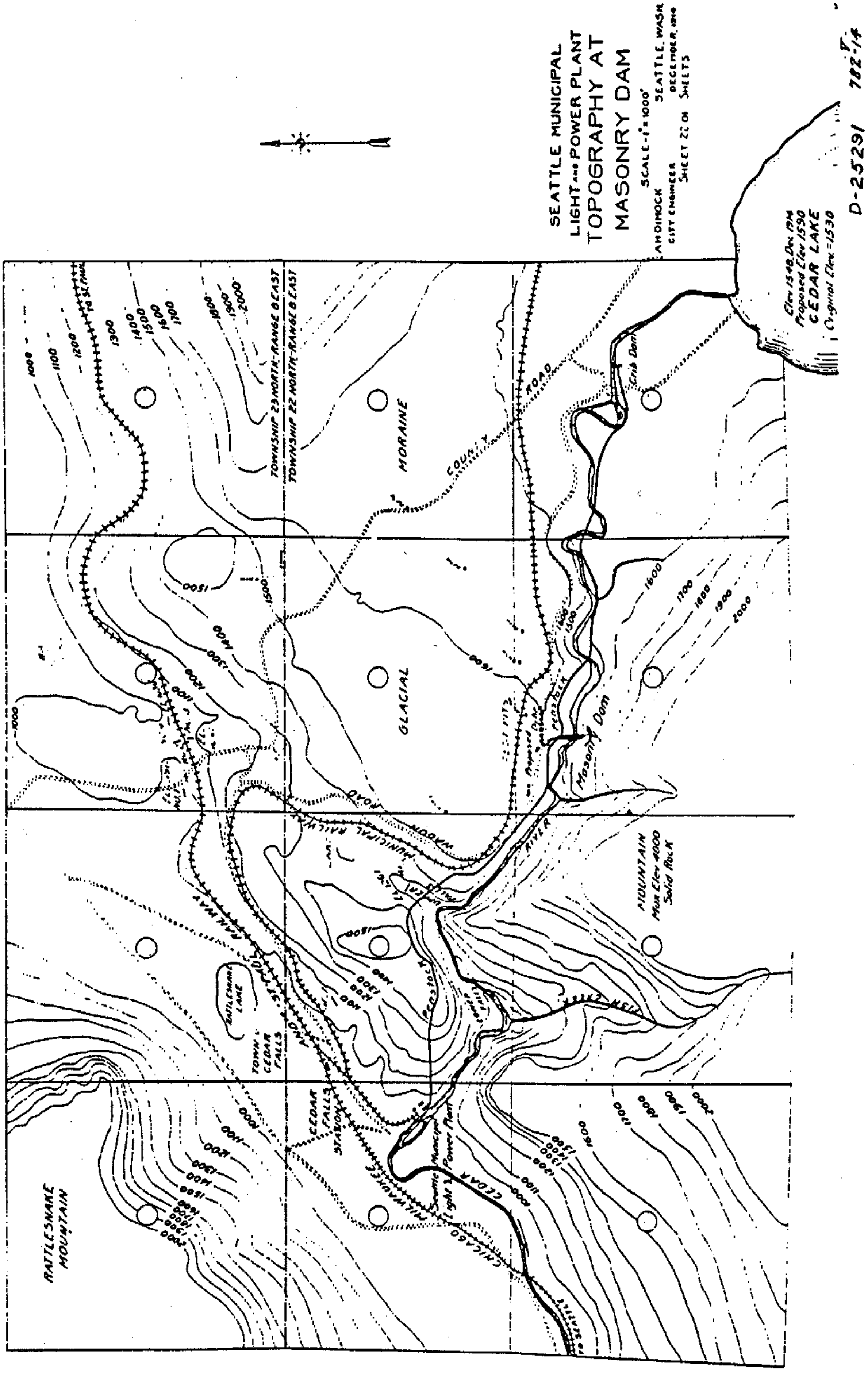

Figure 5.
Topography at Masonry Dam.

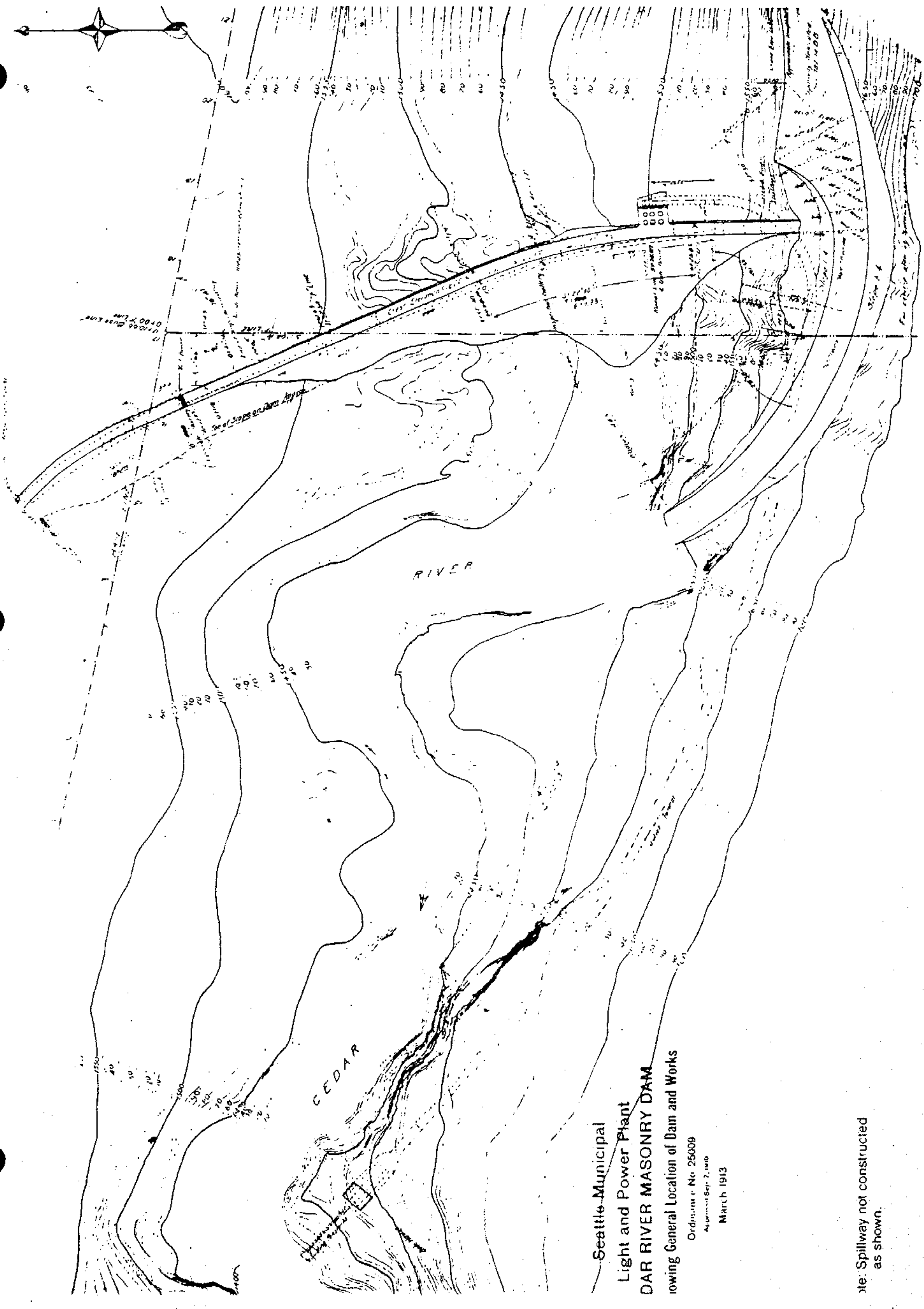

Figure 6.
General location of Masonry Dam and works.

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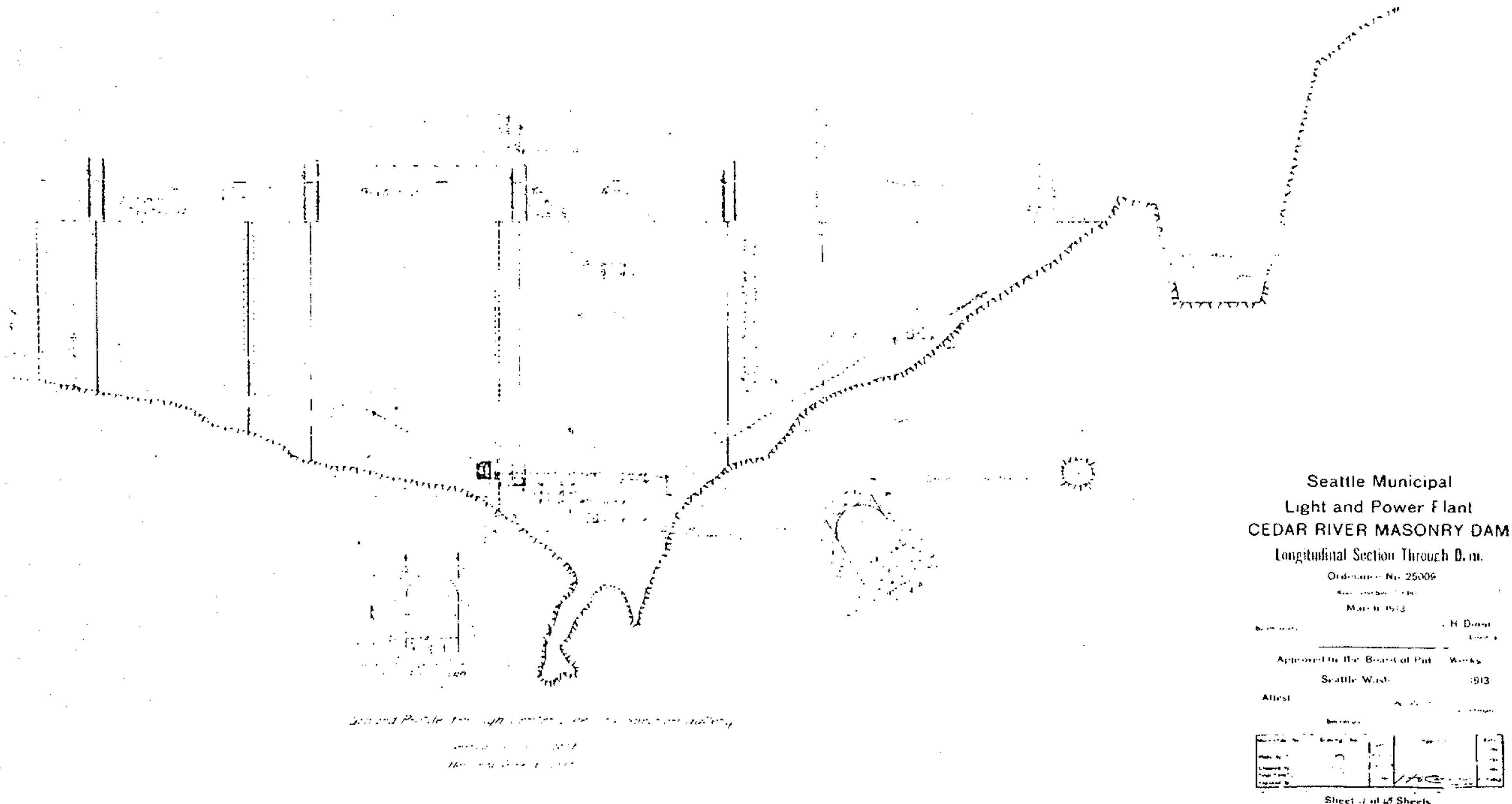

Note: Spillway not constructed
as shown

Figure 7.
Longitudinal section through
Masonry Dam.

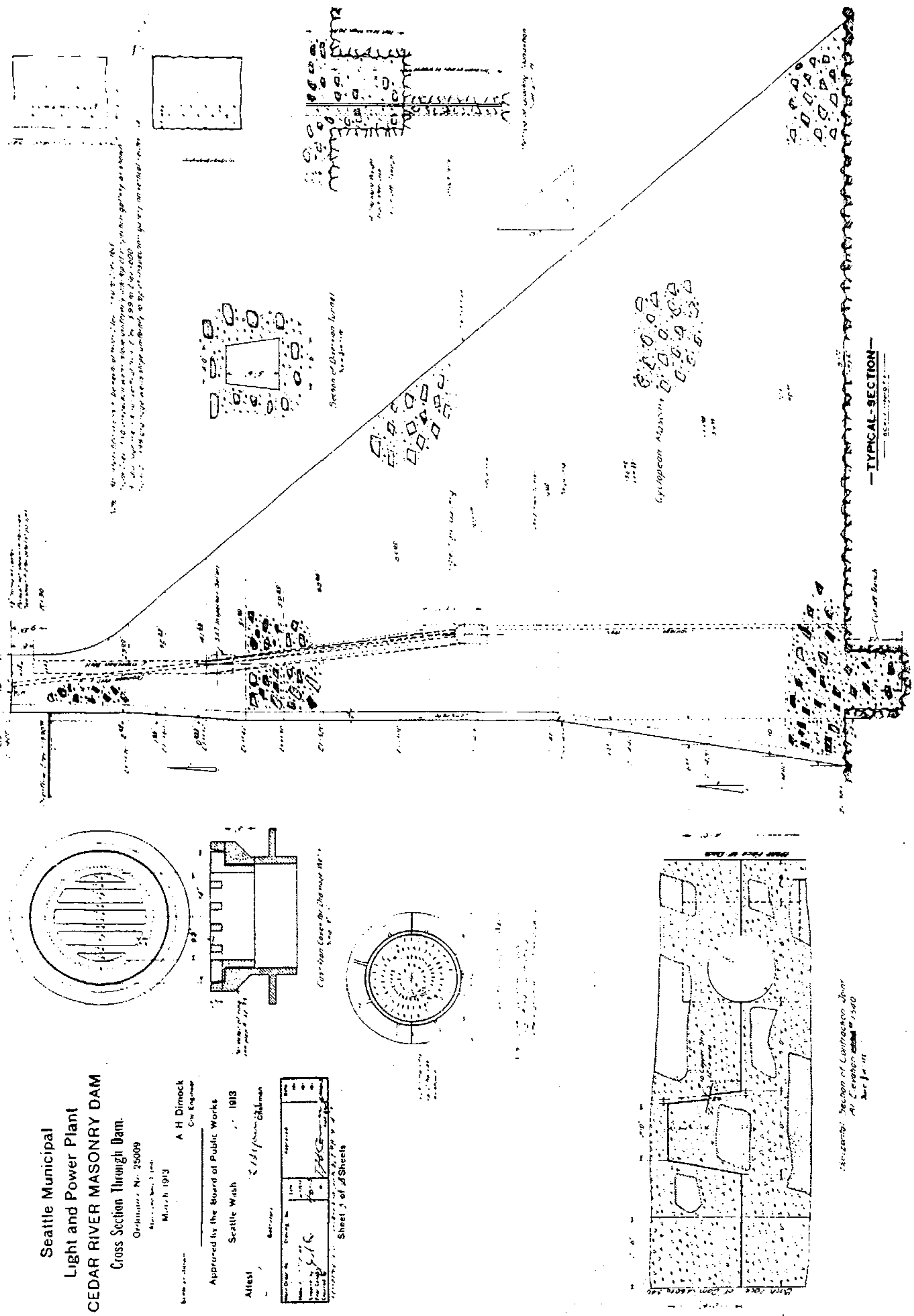

Figure 8.
Cross section through
Masonry Dam.

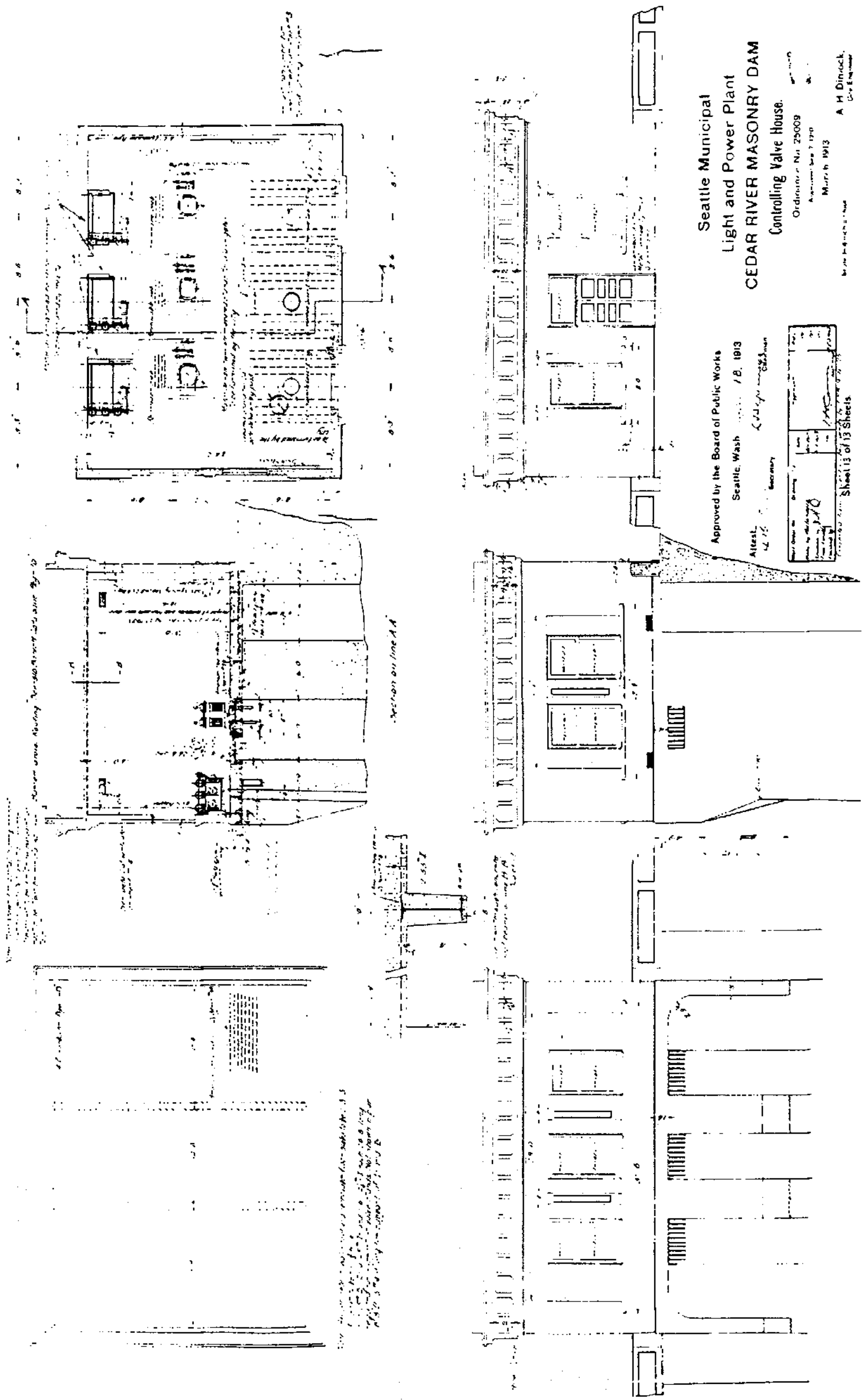

Figure 9.
Controlling valve house.

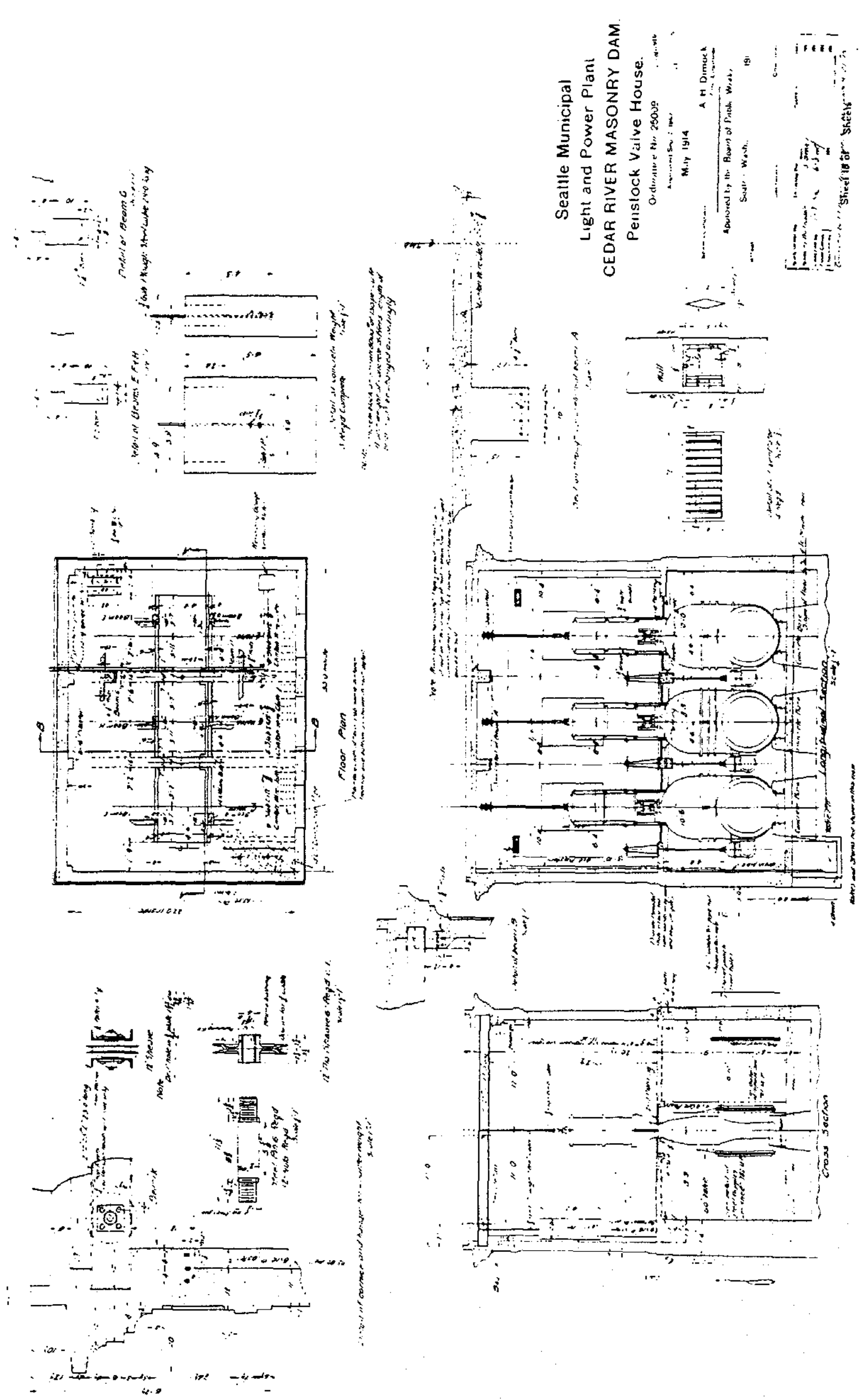

Figure 10.
Penstock valve house.

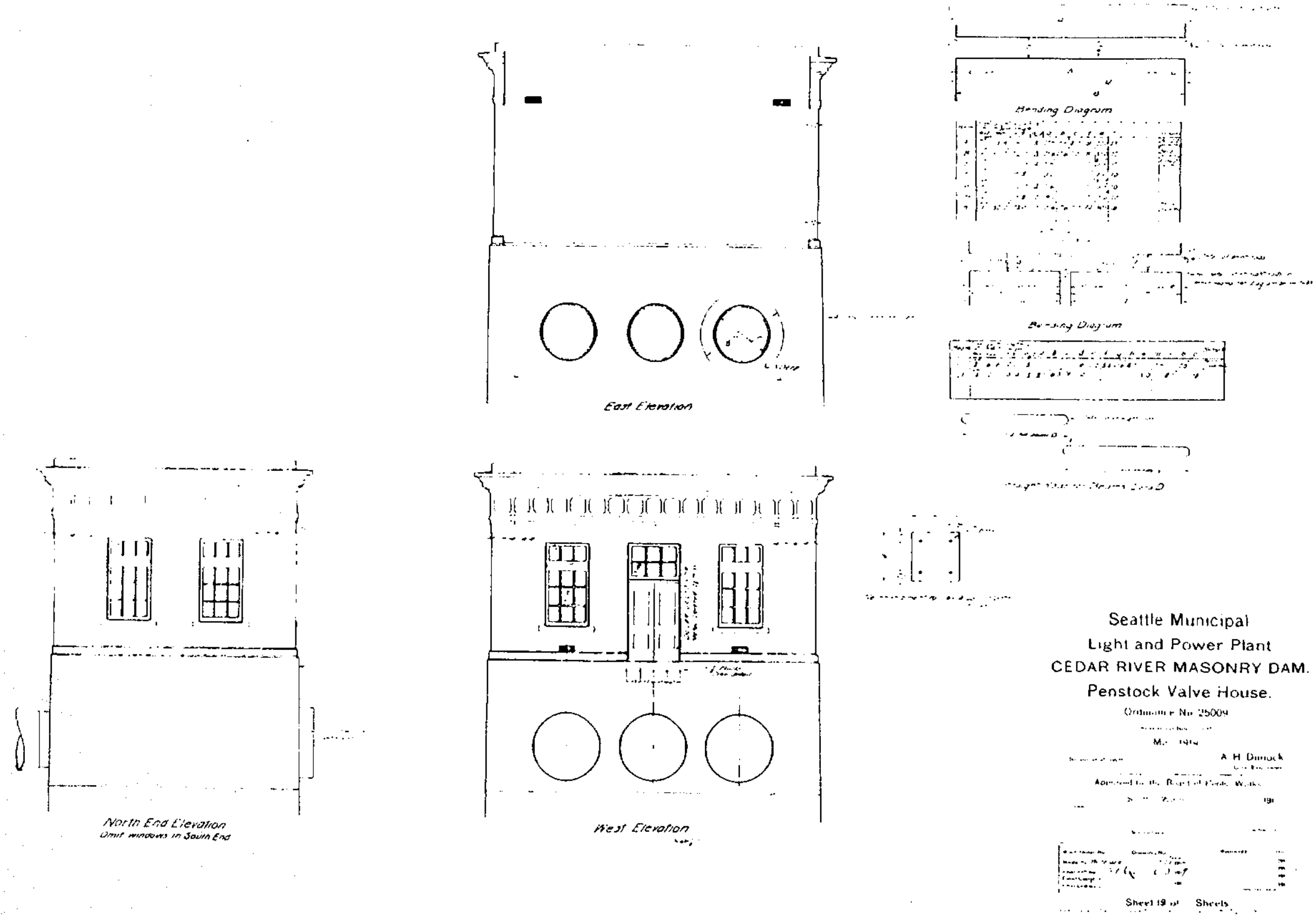

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Figure 11.
Penstock valve house.